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Activity of micro VT earthquakes derived from repeating seismic observations using OBSs around Sakurajima Volcano

YAKIWARA, Hiroshi[1*] ; HIRANO, Shuichiro[1] ; MIYAMACHI, Hiroki[1] ; TAKAYAMA, Tetsuro[2] ; ICHIKAWA, Nobuo[2] ; TAMEGURI, Takeshi[2] ; IGUCHI, Masato[2]

[1]GSE, Kagoshima Univ., [2]SVRC, DPRI, Kyoto Univ.

We have performed seismic observations with three or four Ocean Bottom Seismographs (OBSs) around Sakurajima Volcano, in order to observe micro volcano-tectonic earthquakes (MVTs) which occur beneath sea bottom of Kagoshima Bay. Although the observation cannot be continuously conducted through a year, we successfully retrieved all OBSs for six observation periods (P0 to P5) from 2009 to 2014. Yakiwara et al. (2014, JpGU) compared the hypocenter distributions with three-dimensional seismic velocity model of the upper crust in and around the volcano, though several problems to be solved were remained; 1) the hypocenters were determined using a one dimensional velocity model (Kakuta et al., 1991: Vp/Vs=1.73=const.) optimized for regional area of southern Kyushu Island, 2) Station corrections were not estimated adequately, 3) Temporal changes of the hypocenters were not be mentioned. We therefore re-evaluated the corrections to alternative velocity models, and relocated the hypocenters. Present study reports the comparisons between relocated hypocenters and temporal changes of baseline lengths of GEONET stations, and a three-dimensional resistivity in and around Aira Caldera (Kanda et al., 2013).

As alternative velocity models, we adopted one- and three- dimensional velocity models derived from tomographic modeling in and around central and southern Kyushu (Yakiwara et al., 2013, IAVCEI; Yakiwara et al., 2014, JpGU). Selecting earthquakes used in the tomographic studies and also observed by the OBSs, medians of travel time residuals for each model were assigned as station corrections. Then, hypocenter relocations were performed by use of the corrections and the velocity models. Among the relocations, the hypocenter distributions determined by three-dimensional velocity model is most suitable in that the residuals reached minimal.

Among the observation periods, the relatively obvious increase of baseline elongations was observed only in P3 (October,2011 to January,2012). We therefore estimate P3 as an acceleration period of ground expansion in and around Aira Caldera. The ground deformation corresponds to magma accumulations at a main magma reservoir of the volcano. In the period of P3, MVTs from 7 to 15 km depth were activated beneath the area between Wakamiko Caldera and northeast coast of Sakurajima Volcano. On the other hand the ground deformation seems to be stationary in P5 (November,2013 to March,2014) because the baseline lengths did not change significantly. In this period, only few MVTs occurred 3 to 6 km depth beneath Wakamiko Caldera. No earthquake was observed below 7 km depth. The activity and depth range of MVTs in P5 were different from ones in P3. The ground expansion progressed on average rate in P1, P2, and P5. Almost MVTs occurred at depth range from 3 to 6 km beneath Wakamiko Caldera. The relatively deep MVTs below 7 km depth may occurred due to stress changes generated the magma accumulations at main reservoir of the volcano. We suppose that the shallow MVTs from 3 to 6 km beneath Wakamiko Caldera relates to hydrothermal activities supplying fluid to sea bottom fumaroles. We also compared the hypocenters of MVTs with a three-dimensional resistivity structure (Kanda et al., 2013). The hypocenters locate around the low resistivity area and/or the top of the area. This comparison supports that the shallow MVTs may relate the hydrothermal activity beneath Wakamiko Caldera.

Keywords: Sakurajima Volcano, Volcano-tectonic earthquakes, Three-dimensional velocity model, Three-dimensional resistivity structure